



NUCLEAR TERRORISM AND NUCLEAR WEAPONS -- PRINCIPLES OF RADIATION

Subject: Science | Current: 2010 | Grade: 9-12

Day: 1 of 4

1 Purpose ----- To have the student become aware of basic components of radiation and radioactivity.

2 Duration of Lesson ----- 50 min.

3 Additional Topics ----- None

4 Objectives ----- Students should be able to:

- Understand the structure of the atom.
- Understand the major forms of ionizing radiation.
- Understand radiation and isotopes, and be able to define each term.
- List and explain the major effects of a nuclear detonation.
- Name and describe the main isotopes which are used to manufacture a nuclear device.

5 Standards Addressed & Benchmarks ----- **BIOLOGY**

Explain that gene mutations can be caused by such things as radiation and chemicals. Understand that when they occur in sex cells, the mutations can be passed onto offspring; if they occur in other cells, they can be passed on to descendant cells only. (Core Standard)

B.1.24

Explain that gene mutations in a cell can result in uncontrolled cell division, called cancer. Also know that exposure of cells to certain chemicals and radiation increases mutations and thus increases the chance of cancer.

B.1.25



PHYSICS

Identify electromagnetic radiation as a wave phenomenon after observing refraction, reflection, and polarization of such radiation. (Core Standard)

P.1.26

FAMILY AND CONSUMER SCIENCES

Describe the various types of irradiation used in food preparation/processing including the amount of energy produced by each type of radiation and the dosage effects.

FS.1.15

Describe agents that lead to inactivation of microorganisms including heat and heat processing, cleaning and sanitizing agents, food preservatives, irradiation and ultraviolet (UV) light, and high pressure. Discuss their mode of action. Describe the electromagnetic spectrum using frequency and wavelength, and identify types of electromagnetic radiation appropriate for use in irradiation of food. In addition, express an understanding of the "hurdle effect" used to ensure microbial safety.

FS.2.5

HEALTH CAREERS EDUCATION

Define: acidosis, alkalosis, ketosis, radiation sickness

AP.2.16

CHEMISTRY

Students begin to conceptualize the general structure of the atom and the roles played by the main parts of the atom in determining the properties of materials. They investigate, through such methods as laboratory work, the nature of chemical changes and the role of energy in those changes.

C.1

Use the principle of conservation of mass to make calculations related to chemical reactions. Calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products and the relevant atomic masses. (Core Standard)

C.1.13

Explain that chemical bonds between atoms in molecules such as H₂, CH₄, NH₃, H₂CCH₂, N₂, Cl₂, and many large biological molecules are covalent. (Core Standard)

C.1.28

Describe the possible subatomic particles within an atom or ion. (Core Standard)

C.1.32



Use the Periodic Table to compare attractions that atoms have for their electrons and explain periodic properties, such as atomic size, based on these attractions. (Core Standard)

C.1.34

CHEMISTRY-PHYSICS

Students begin to conceptualize the general architecture of the atom and the roles played by the

CP.1

main constituents of the atom in determining the properties of materials. They investigate, using such methods as laboratory work, the different properties of matter. They investigate the concepts of relative motion, the action/reaction principle, wave behavior, and the interaction of matter and energy.

Understand, and give examples to show, that isotopes of the same element have the same numbers of protons and electrons but differ in the number of neutrons.

CP.1.3

Indiana Department of Education. (n.d.). Indiana Standards and Resources: Sciences: Physics, Biology, Chemistry, and Integrated Chemistry and Physics; Family and Consumer Sciences and Health Careers Education. Retrieved from <http://dc.doe.in.gov/Standards/AcademicStandards/StandardSearch.aspx>

6 Vocabulary

----- These terms are included in the lesson plan:

- **Alpha radiation:** A relatively heavy form of radiation composed of two protons plus two neutrons.
- **Beta radiation:** A low-energy form of radiation; a particle essentially identical to an electron.
- **Gamma radiation:** Electromagnetic radiation of high energy and high penetrating power.
- **Isotope:** An element with a fixed number of protons but variable level of neutrons. May be unstable.
- **Neutron:** Particle of high energy and high penetrating power.
- **Radioactive:** An element containing excess energy within its nucleus

7 Materials

----- Students need paper on which to take notes, Lecture 1, Supplementary Material File



8 Additional Resources ----- None

9 Procedures & Methods ----- The lesson plan's course is as follows:

- The teacher will give the lecture from the supplementary material file
- During the lecture, the students are to take notes to use to study for the exam at the end of the unit.

A. Introduction

Nuclear weapons are the most powerful of all weapons of mass destruction (WMD). The detonation of a nuclear device by a terrorist group would result in catastrophic physical effects including blast overpressure, thermal effects and radiation contamination. It could also cause tremendous psychological impacts worldwide.

During the Cold War between the United States and the Soviet Union (late 1940s to early 1990s),

the nations of the world lived with the constant threat of nuclear war. With the end of the Cold War came the hope that the nuclear arsenals stockpiled by these and other countries would eventually be dismantled. Unfortunately, however, international terrorist organizations have recently made efforts to gain access to WMDs, including nuclear weapons, by attempting to recruit nuclear weapon scientists. In addition, certain nuclear nations may still pose a military threat to others.

It is essential for the emergency responder to be aware of the potential threat of nuclear hazards. This includes being able to understand the basic components of nuclear and radiological weapons.

B. Development

On the first day the instructor will go over the introduction and the background of nuclear hazards, specifically nuclear radiation. On the second day will be a survey of the various types of nuclear weapons. The third day will encompass a discussion of the effects of nuclear weapons. On the fourth day the students will use a computer model to predict possible blast and fallout effects from a major nuclear detonation in the United States.

During Days 1-3 the class will take notes. They will also discuss how a nuclear incident would impact their community and the larger region (e.g., state, Midwest U.S.), should an attack ever occur there.



C. Practice

On the second day the material on nuclear radiation from the previous day will be reviewed. The instructor will give a lecture about nuclear weapons and the students will add it to their previous day's notes. The class will then brainstorm recommendations for preventing a nuclear attack by a terrorist organization. The teacher will add to this list recommendations that the students may not have included, which are in the lecture notes.

D. Independent Practice

On the fourth day the students will complete the computer model activity.

E. Accommodations (Differentiated Instruction)

Students who have visual, mobile or hearing impairments may need adaptive computer software to assist with using the computer and accessing the websites for information during the

simulation. Students who are ELL as well as other students who may have developmental issues may need more scaffolding during the simulation to be able to complete it. This could be in the form of additional prompts for each question and a graphic organizer, perhaps a flow chart, to assist them in staying on track and managing the information.

For highly able/gifted students, you may want to make the simulation more abstract, by giving them less structured questions. You may just provide them with the scenario; let them figure out what needs to happen next, where to go for information, and so forth. Check in with them, ask some probing questions, and then give them the updates to the scenario.

F. Checking for understanding

The teacher will ask multiple-choice questions throughout the presentation to check for understanding and have the students answer them on a separate sheet of paper. The answer will be provided right away. These questions will not be turned in for a grade but rather the teacher will walk around and see who has missed what questions, have the students give a thumbs up if they got the question correct, etc., so that he/she will have an idea of if the students are understanding the material.

G. Closure

Careers in this area include:

Directorate for Science and Technology:

- http://www.dhs.gov/xabout/structure/editorial_0530.shtm
- Domestic Nuclear Detection Office: http://www.dhs.gov/xabout/structure/editorial_0766.shtm
- Federal Bureau of Investigation: www.fbi.gov
- Federal Emergency Management Agency: www.fema.gov
- U.S. Department of Homeland Security: www.dhs.gov



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10 Evaluation

- U.S. Coast Guard: <http://uscg.mil>
- U.S. Immigration and Customs Enforcement: www.ice.gov

At the end of the unit, the students will be given a written exam that covers all of the topics covered.

11 Teacher Reflection

The teacher will reflect on the results of the lesson after teaching it.

12 Resources & Media

Lecture 1, Supplementary Material File
Directorate for Science and Technology:

- http://www.dhs.gov/xabout/structure/editorial_0530.shtm
- Domestic Nuclear Detection Office: http://www.dhs.gov/xabout/structure/editorial_0766.shtm
- Federal Bureau of Investigation: www.fbi.gov
- Federal Emergency Management Agency: www.fema.gov
- U.S. Department of Homeland Security: www.dhs.gov
- U.S. Coast Guard: <http://uscg.mil>
- U.S. Immigration and Customs Enforcement: www.ice.gov

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